generating sites that could not ship spent nuclear fuel in rail casks while operational. The risk would occur over 38 years.

Traffic Fatalities

The analysis estimated traffic fatalities from accidents involving the transport of spent nuclear fuel and high-level radioactive waste (including the rail portion of transportation to and from an intermodal transfer station) in Nevada for the heavy-haul truck implementing alternatives for shipments of the materials included in Inventory Modules 1 and 2. Table J-60 lists the estimated number of fatalities that would occur over 38 years for a branch rail line and for each of the five candidate routes for heavy-haul trucks. The estimate for traffic fatalities includes accident risk in Nevada from about 3,100 legal-weight truck shipments from commercial generators that could not ship spent nuclear fuel in rail casks while operational.

J.3.6 IMPACTS FROM TRANSPORTATION OF OTHER MATERIALS

Other types of transportation activities associated with the Proposed Action would involve shipments of materials other than the spent nuclear fuel and high-level radioactive waste discussed in previous sections. These activities would include the transportation of people (commuter transportation). This section evaluates occupational and public health and safety and air quality impacts from the shipment of:

- Construction materials, consumables, and personnel for repository construction and operation, including repository components (disposal containers, emplacement pallets, drip shields, and solar panels).

- Waste including low-level waste, construction and demolition debris, sanitary and industrial solid waste, and hazardous waste

- Office and laboratory supplies, mail, and laboratory samples

The analysis included potential impacts of transporting these materials for the flexible design, in which the repository would be open for 76 years after emplacement, and for several lower-temperature operating scenarios that would leave the repository open and ventilated for 125 to 300 years, a surface facility that would provide storage during a cooling period, and the use of derated waste packages. The analysis assumed that material would be shipped across the United States to Nevada by rail, but that DOE would not build a rail line to the proposed repository, because the larger number of truck shipments would lead to higher impacts than those for rail shipments, as discussed above. In addition, because the construction schedule for a new rail line would coincide with the schedule for the construction of repository facilities, trucks would deliver materials for repository construction.

Rail service would benefit the delivery of the 11,300 disposal containers from manufacturers. Two 33,000-kilogram (about 73,000-pound) disposal containers and their 700-kilogram (about 1,500-pound) lids (DIRS 155347-CRWMS M&O 1999, all) would be delivered on a railcar—a total of 5,650 railcar deliveries over the 24-year period of the Proposed Action (8,400 railcar deliveries if DOE used 17,000 derated waste packages). These containers would be delivered to the repository along with shipments of spent nuclear fuel and high-level radioactive waste or separately on supply trains along with shipments of materials and equipment.

Disposal container components that would weigh as much as 34 metric tons (37.5 tons) would be transported to Nevada by rail and transferred to overweight trucks for shipment to the repository site. Overweight truck shipments would move the 11,300 (or 17,000 if derated) containers from a railhead to the site. The State of Nevada routinely provides permits to motor carriers for overweight, overdimension

loads if the gross vehicle weight does not exceed 58.5 metric tons (64.5 tons) (DIRS 155347-CRWMS M&O 1999, Request #046).

J.3.6.1 Transportation of Personnel and Materials to Repository

The following paragraphs describe impacts that would result from the transportation of construction materials, consumables, repository components, supplies, mail, laboratory samples, and personnel to the repository site during the construction, operation and monitoring, and closure phases of the Proposed Action.

Human Health and Safety

Most construction materials, construction equipment, and consumables would be transported to the Yucca Mountain site on legal-weight trucks. Heavy and overdimensional construction equipment would be delivered by trucks under permits issued by the Nevada Department of Transportation. The analysis assumed that repository components would be manufactured somewhere in the central United States, while other materials and consumables would originate in Nevada. DOE estimates that about 37,000 to 41,000 rail and truck shipments over 5 years would be necessary to transport materials, supplies, and equipment to the site during the construction phase, depending on the operating mode. Surface facilities for aging would require more construction materials.

In addition to construction materials, supplies, equipment, and repository components, trucks would deliver consumables to the repository site. These would include diesel fuel, cement, and other materials that would be consumed in daily operations.

Over the 24-year period of operation, the repository would receive between 6,600 and 10,000 shipments from across the United States, and between 47,000 and 62,000 shipments in Nevada of supplies, materials, equipment, repository components, and consumables, including cement and other materials for underground excavation. The analysis assumed that the Nevada shipments would originate in the Las Vegas metropolitan area. In addition, an estimated 53,000 shipments of office and laboratory supplies and equipment, mail, and laboratory samples would occur during the 24 years of operation. About 27 million to 41 million vehicle kilometers nationally (17 million to 25 million vehicle miles) of travel, and about 34 million to 40 million kilometers (21 million to 25 million miles) in Nevada would be involved. Impacts would include vehicle emissions, consumption of petroleum resources, increased truck traffic on regional highways, and fatalities from accidents. Similarly, there would be about 43 to 760 shipments nationally, and 190,000 to 720,000 shipments in Nevada during the 76-to-300-year monitoring period after emplacement operations and about 35,000 shipments, more than 99 percent in Nevada, during closure activities. Table J-64 summarizes these impacts.

Table J-64. Human health and safety impacts from national and Nevada shipments of material to the repository.

Phase	Kilometers[a] traveled (millions)	Traffic fatalities	Fuel consumption (millions of liters)[b]	Vehicle emissions-related fatalities
Construction (5 years)	8.9 - 10	0.15 - 0.21	2.9 - 10	0.019 - 0.022
Emplacement and development (24 years)	61 - 81	2.7 - 3.9	430 - 650	0.14 - 0.19
Monitoring (76 to 300 years)	47 - 170	0.8 - 3.0	13 - 65	0.10 - 0.36
Closure (10 to 17 years)	8.4 - 8.9	0.14 - 0.17	2.2 - 8.1	0.018 - 0.019
Totals[c]	*130 - 270*	*3.8 - 7.2*	*450 - 720*	*0.27 - 0.59*

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. Totals might not equal sums due to rounding.

During the construction phase, many employees would use their personal automobiles to travel to construction areas on the repository site and to highway or rail line construction sites. The estimated average annual level of direct employment during repository surface and subsurface construction would be between 1,500 and 1,600 workers, depending on the operating mode. Current Nevada Test Site employees can ride DOE-provided buses to and from work; similarly, buses probably would be available for repository construction workers. The use of buses and car pools would result in an average vehicle occupancy of 8.6 persons per vehicle. Table J-65 summarizes the anticipated number of traffic-accident-related injuries and fatalities and the estimated consumption of gasoline that would occur from this travel activity. The greatest impact of this traffic would be added congestion at the northwestern Las Vegas Beltway interchange with U.S. Highway 95. Current estimates call for traffic at this interchange during rush hours to be as high as 1,000 vehicles an hour (DIRS 103710-Clark County 1997, Table 3-12, p. 3-43). The additional traffic from repository construction, assuming that the peak traffic would be 3 times the average, would be an estimated 600 vehicles per hour and would add about 35 percent to traffic volume at peak rush hour and would contribute to congestion although congestion in this area would be generally low.

Table J-65. Health impacts and fuel consumption from transportation of construction and operations workers.

Phase	Kilometers[a] traveled (in millions)	Traffic fatalities	Fuel consumption (millions of liters)[b]	Vehicle emissions-related fatalities
Construction	51 - 56	0.51 - 0.56	8.5 - 8.7	0.067 - 0.074
Emplacement and development (24 years)	290 - 440	2.9 - 4.4	48 - 73	0.38 - 0.58
Monitoring (76 to 300 years)	87 - 280	0.87 - 2.8	14 - 45	0.11 - 0.36
Closure	48 - 62	0.48 - 0.62	8.0 - 10	0.063 - 0.082
Totals[c]	*480 - 800*	*4.8 - 8.0*	*79 - 130*	*0.63 - 1.1*

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. Totals might not equal sums due to rounding.

The average annual employment during emplacement and development operations would be between 1,700 and 2,600 workers. As mentioned above, DOE provides bus service from the Las Vegas area to and from the Nevada Test Site. Table J-65 summarizes the anticipated number of traffic-accident-related fatalities and the estimated consumption of gasoline that would occur from this travel activity. The greatest impact of this traffic would be increased congestion at the northwestern Las Vegas Beltway interchange with U.S. 95. As many as 600 to 850 vehicles an hour at peak rush hour would contribute to the congestion. Approximately 130 to 160 people would be employed annually during monitoring and about 460 to 600 would be employed annually during closure. The number of vehicles associated with these levels of employment, about 70 at most, would contribute negligibly to congestion.

Table J-66 lists the impacts associated with the delivery of fabricated disposal container components from a manufacturing site to the repository. A total of 11,300 containers (17,000 under the derated waste package scenario) would be delivered; if a rail line to Yucca Mountain was not available, the mode of transportation would be a combination of rail and overweight truck. The analysis assumes that the capacity of each railcar would be two containers and that the capacity of a truck would be one container, so there would be 5,650 railcar shipments to Nevada and 11,300 truck shipments to the Yucca Mountain site (8,400 rail shipments and 17,000 truck shipments if derated waste packages were used). The analysis estimated impacts for one national rail route representing a potential route from a manufacturing facility to a Nevada rail siding. The analysis estimated the impacts of transporting the containers from this siding over a single truck route—the Apex/Dry Lake route analyzed for the transportation of spent nuclear fuel and high-level radioactive waste by heavy-haul trucks. Although the actual mileage from a manufacturing facility could be shorter, DOE decided to select a distance that represents a conservative

Table J-66. Impacts of disposal container shipments for 24 years of the Proposed Action.[a]

Type of shipment	Number of shipments	Vehicle emissions-related health effects	Traffic fatalities
Rail and truck	5,650 - 8,400 rail/ 11,300 - 17,000 truck	0.088 - 0.13	2.2 - 3.2

a. Impacts of transporting drip shields and emplacement pallets are included in results listed in Table J-64.

estimate [4,439 kilometers (2,758 miles)]. The impacts are split into two subcategories—health effects from vehicle emissions and fatalities from transportation accidents.

Air Quality

The exhaust from vehicles involved in the transport of personnel and materials to the repository would emit carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter (PM_{10}). Because carbon monoxide is the principal pollutant of interest for evaluating impacts caused by motor vehicle emissions, the analysis focused on it. Table J-67 indicates the basis for selecting carbon monoxide as the principal pollutant of concern.

Table J-67. Listed pollutants and pollutant of interest.

Listed pollutant	Gasoline emissions	Diesel emissions
Carbon monoxide	Total emissions into the basin are larger than for diesel	More per vehicle-mile, but total emissions are less
Sulfur dioxide	Very minor problem with modern gasoline	Emits slightly more than gasoline
Nitrogen oxides	Limit less restrictive than carbon monoxide limit	
Particulate matter	Dust,[b] asphalt, and combustion particles	
Ozone	Limit less restrictive than carbon monoxide limit[c]	
Lead	Not a problem with modern gasoline	Does not produce lead

a. Source: 40 CFR 93.153.
b. Of most concern from earthmoving rather than fuel emissions (see DIRS 155557-Clark County 2001, all).
c. Ozone is not an emission but a product of sunlight acting on hydrocarbons and nitrogen oxides.

The analysis assumed that most of the personnel who would commute to the repository would reside in the Las Vegas area and that most of the materials would travel to the repository from the Las Vegas area. To estimate maximum potential emissions to the Las Vegas Valley airshed, which is in nonattainment for carbon monoxide (DIRS 101826-FHWA 1996, pp. 3-53 and 3-54), the analysis assumed that all personnel and material would travel from the center of Las Vegas to the repository. Table J-68 lists the estimated annual amount of carbon monoxide that would be emitted to the valley airshed during the phases of the repository project and the percent of the corresponding threshold level. Although it can be a health hazard (see Table J-65), its emission rate in the Las Vegas basin would be below the standard.

Table J-68. Annual range of carbon monoxide emitted to Las Vegas Valley airshed from transport of personnel and material to repository (kilograms per year)[a] for all modes of the Proposed Action.

Phase	Annual emission rate	Percent of GCR threshold level[b]
Construction	41,000 - 45,000	45 - 50
Emplacement and development	44,000 - 62,000	49 - 69
Operations and monitoring period	6,400 - 8,200	7 - 9
Closure	33,000 - 39,000	36 - 43

a. To convert kilograms to tons, multiply by 0.0011023.
b. GCR = General Conformity Rule; the emission threshold level for carbon monoxide in a nonattainment area is 91,000 kilograms (100 tons) per year (40 CFR 93.153).

As listed in Table J-68, the annual amount of carbon monoxide emitted to the nonattainment area would be below the threshold level during all phases of the Proposed Action. In the operation phase, the estimated annual amount of carbon monoxide emitted would be greatest (49 to 69 percent) to the threshold level. Relative to the vehicle emissions from the repository-bound high-level radioactive waste and spent nuclear fuel, the emissions from the transport of personnel and materials is substantially greater for all transportation implementing alternatives.

DOE conducted a conformity review using the guidance in DIRS 155566-DOE (2000, all) to estimate carbon monoxide emissions from the transportation of personnel, materials, and supplies through the Las Vegas air basin under each transportation implementing alternative. The transportation of personnel, materials, and supplies would be the main repository-related contributor of carbon monoxide to the nonattainment area. Compared to the total from all sources in the nonattainment area, the transportation of personnel, materials, and supplies to Yucca Mountain would add, at most, an additional 0.07 percent to the 2000 daily levels of carbon monoxide in the air basin (DIRS 156706-Clark County 2000, Appendix A, Table 1-3).

For areas that are in attainment, pollutant concentrations in the ambient air probably would increase due to the additional traffic but, given the relatively small amount of traffic that passes through these areas, the additional traffic would be unlikely to cause the ambient air quality standards to be exceeded.

Noise

Traffic-related noise on major transportation routes used by the workforce would likely increase. The analysis of impacts from traffic noise assumed that the workforce would come from Nye County (20 percent) and Clark County (80 percent). During the period of maximum employment in 2015, the analysis estimated a daily maximum of 576 vehicles would pass through the Gate 100 entrance at Mercury during rush hour [compared to a baseline of 232 vehicles per hour (DIRS 101811-DOE 1996, pp. 4-43 and 4-45)]. One-hour equivalent rush hour noise levels resulting from increased traffic would increase by 3.4 dBA at Indian Springs and 4.4 dBA at Mercury over background noise levels of 66.6 and 65.5 dBA, respectively. The increase could be perceptible to the community but, because of its short duration and existing highway noise, would be unlikely to result in an adverse public response.

J.3.6.2 Impacts of Transporting Wastes from the Repository

During repository construction and operations, DOE would ship waste and sample material from the repository. The waste would include hazardous, mixed, and low-level radioactive waste. Samples would include radioactive and nonradioactive hazardous materials shipped to laboratories for analysis. In addition, nonhazardous solid waste could be shipped from the repository site to the Nevada Test Site for disposal. However, as noted in Chapter 2, DOE proposes to include an industrial landfill on the repository site. Table J-69 summarizes the health impacts from wastes that DOE would ship from the repository.

Table J-69. Health impacts and fuel consumption from transportation of waste from the Yucca Mountain repository.

Phase	Kilometers[a] traveled (in millions)	Traffic fatalities	Fuel consumption (millions of liters)[b]	Vehicle emissions-related fatalities
Construction	0.37 - 0.39	0.0061 - 0.0066	0.086 - 0.092	0.00077 - 0.0082
Emplacement and development (24 years)	2.8 - 3.1	0.047 - 0.051	0.67 - 0.72	0.0040 - 0.0043
Monitoring (76 to 300 years)	1.8 - 6.2	0.031 - 0.10	0.44 - 1.5	0.0026 - 0.0088
Closure	0.67 - 0.88	0.011 - 0.020	0.16 - 0.24	0.0014 - 0.0025
Totals [c]	6.1 - 11	0.10 - 0.18	1.4 - 2.5	0.0093 - 0.016

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. Totals might not equal sums due to rounding.

Occupational and Public Health and Safety

The quantities of hazardous waste that DOE would ship to approved facilities off the Nevada Test Site would be relatively small and would present little risk to public health and safety. This waste could be shipped by rail (if DOE built a rail line to the repository site) or by legal-weight truck to permitted disposal facilities. The principal risks associated with shipments of these materials would be related to traffic accidents. These risks would include 0.01 fatality for the combined construction, operation and monitoring, and closure phases for hazardous wastes.

DOE probably would ship low-level radioactive waste by truck to existing disposal facilities on the Nevada Test Site. Although these shipments would not use public highways, DOE estimated their risks. As with shipments of hazardous waste, the principal risk in transporting low-level radioactive waste would be related to traffic accidents. Because traffic on the Nevada Test Site is regulated by the Nye County Sheriff's Department, DOE assumed that accident rates on the site are similar to those of secondary highways in Nevada. Low-level radioactive waste would not be present during the construction of the repository. Therefore, accidents involving such waste could occur only during the operation and monitoring and the closure phases, although most of this waste would be generated during the construction and operation and monitoring phases. DOE estimates between 0.0038 and 0.0053 traffic fatality from the transportation of low-level radioactive waste during the repository construction, operation and monitoring, and closure phases. Table J-69 lists the impacts of transporting wastes, including hazardous waste, sanitary waste, construction debris, and low-level radioactive waste.

Air Quality

The quantities of hazardous waste that DOE would ship to approved facilities off the Nevada Test Site would be relatively small. Vehicle emissions due to these shipments would present little risk to public health and safety.

Biological Resources and Soils

The transportation of people, materials, and wastes during the construction, operation and monitoring, and closure phases of the repository could involve between 610 and 1,100 million vehicle-kilometers (between 380 and 680 million vehicle-miles) of travel on highways in southern Nevada depending on the repository operating mode. This travel would use existing highways that pass through desert tortoise habitat. Individual desert tortoises probably would be killed. However, because populations of the species are low in the vicinity of the routes (DIRS 103160-Bury and Germano 1994, pp. 57 to 72), few would be lost. Thus, the loss of individual desert tortoises due to repository traffic would not be likely to be a threat to the conservation of this species. In accordance with requirements of Section 7 of the Endangered Species Act (16 U.S.C. 1531 *et seq.*), DOE would consult with the Fish and Wildlife Service and would comply with mitigation measures resulting from that consultation to limit losses of desert tortoises from repository traffic.

J.3.6.3 Impacts from Transporting Other Materials and People in Nevada for Inventory Modules 1 and 2

The analysis evaluated impacts to occupational and public health and safety in Nevada from the transport of materials, wastes, and workers (including repository-related commuter travel) for construction, operation and monitoring, and closure of the repository that would occur for the receipt and emplacement of materials in Inventory Modules 1 and 2. The analysis assumed that the routes and transportation characteristics (for example, accident rates) for transportation associated with the Proposed Action and Inventory Modules 1 and 2 would be the same. The only difference would be the projected number of trips for materials, wastes, and workers traveling to the repository.

Table J-70 lists estimated incident-free (vehicle emissions) impacts and traffic (accident) fatality impacts in Nevada for the transportation of materials, wastes, and workers (including repository-related commuter travel) for the construction, operation and monitoring, and closure of the repository that would occur for the receipt and emplacement of the materials in Inventory Modules 1 and 2. The range includes all lower-temperature repository operating mode scenarios.

Table J-70. Health impacts from transportation of materials, consumables, personnel, and waste for Modules 1 and 2.[a]

Phase	Kilometers traveled (millions)[b]	Traffic fatalities	Emission-related health effects
Construction	61 - 67	0.67 - 0.74	0.086 - 0.096
Emplacement and Development	510 - 640	8.5 - 9.8	0.78 - 0.92
Operation and Monitoring	150 - 480	1.9 - 6.1	0.24 - 0.79
Closure	59 - 97	0.65 - 1.0	0.084 - 0.13
Totals	***820 - 1,200***	***12 - 18***	***1.2 - 1.9***

a. Numbers are rounded.
b. To convert kilometers to miles, multiply by 0.62137.
c. Totals might not equal sums due to rounding.

Even with the increased transportation of the other materials included in Module 1 or 2, DOE expects that the transportation of materials, consumables, personnel, and waste to and from the repository would be minor contributors to all transportation on a local, state, and national level. Public and worker health impacts would be small from transportation accidents involving nonradioactive hazardous materials. On average, in the United States there is about 1 fatality caused by the hazardous material being transported for each 30 million shipments by all modes (DIRS 103717-DOT 1998, p. 1; DIRS 103720-DOT Undated, Exhibit 2b).

J.4 State-Specific Impacts and Route Maps

This section contains maps and tables that illustrate the estimated impacts to 45 states and the District of Columbia (Alaska and Hawaii are not included; estimated impacts in Montana, North Dakota, and Rhode Island would be zero). As discussed previously in this appendix, DOE used state- and route-specific data to estimate transportation impacts. At this time, about 10 years before shipments could begin, DOE has not determined the specific routes it would use to ship spent nuclear fuel and high-level radioactive waste to the proposed repository. Therefore, the transportation routes discussed in this section might not be the exact routes actually used for shipments to Yucca Mountain. Nevertheless, because the analysis is based primarily on the existing Interstate Highway System and rail rolling stock, the analysis presents a representative estimate of what the actual transportation impacts would likely be.

In addition, under the national mostly rail transportation scenario, potential impacts in each state vary according to the ending node in Nevada. There are six different points of transfer from national to Nevada transportation (Caliente, Dry Lake, Jean, Beowawe, Eccles, and Apex). The routes used in the national analysis depend on the transfer point through which the shipments would pass. Tables J-71 through J-92 list the transportation impacts for 47 of the states and the District of Colombia, and Figures J-31 through J-52 are maps of the routes analyzed for each region.

In Nevada, the impacts vary according to the rail or heavy-haul implementing alternative. Figure J-53 shows the potential routes in the State of Nevada, and Table J-93 lists the impacts in Nevada for each of the eight implementing alternatives.